April 1999

To the People of the Commonwealth:

Since its establishment four years ago, the Massachusetts Strategic Envirotechnology Partnership (STEP) has made significant progress in helping develop and promote effective technology-based solutions to environmental challenges across the Commonwealth. This success has enabled STEP to meet its mission of not only benefiting the environment but also fostering the growth and competitiveness of Massachusetts industry.

STEP is a unique collaboration among three state agencies – the Executive Office of Environmental Affairs, the Department of Economic Development, and the University of Massachusetts (UMass). Working together, our institutions have both assisted innovative environmental companies in commercializing their technologies and aided industrial firms in developing new approaches for reducing waste and preventing pollution. During the past year, more than 120 companies have received some form of business, technical, and regulatory assistance from the STEP program.

This year's Annual Report provides an overview of the services provided by each of the STEP partners. It also describes STEP's six major services and shows how individual companies have benefited from each of those services.

We are especially pleased to report the results of a three-year program review of STEP, conducted by the UMass Donahue Institute. According to the review, over 80% of the STEP companies surveyed by the Institute report that STEP assistance was important or critical to the advancement of their technologies, and 94% would recommend STEP to other companies in need of similar services. In addition, the Donahue Institute identified ways in which we can continuously improve the STEP program to better meet the needs of its users in the future.

We have enjoyed another successful year, working together on behalf of the state's economy and environment. But we are committed to strengthening the partnership even further in the coming year and making it a truly powerful engine for technological innovation and environmental improvement in the Commonwealth.

With regards,

William M. Bulger
President
University of Massachusetts

Robert Durand
Secretary
Executive Office of
Environmental Affairs

Carolyn Boviard
Director
Department of
Economic Development

Massachusetts Strategic Envirotechnology Partnership

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1998 STEP Highlights

Now in its fifth year, the Strategic Envirotechnology Partnership (STEP) is making continued progress in its mission to promote the growth of promising environmental and energy technologies in Massachusetts.

- During 1998, the STEP program provided a broad range of business and technical assistance to more than 120 companies with promising solutions to Massachusetts environmental problems.

- Capital markets continued to favor environmental companies that have received STEP assistance, with almost $6 million invested to date. During 1998, recipients of private investment include **Applied Advanced Technologies** (Winchester), **CASTion** (Ludlow), **Environmental Management Technologies** (Milton), **Ion Signature Technology** (Cambridge), and **SolmeteX** (Billerica).

- The University of Massachusetts (UMass) System partnered with industry to undertake more than 40 applied research and development projects, ranging from developing nontoxic coolants for use in manufacturing to refining ground-source heat pump technology.

- "Over 80% of customers indicate that the services they received through STEP were important or critical to their technology's advancement," according to a survey by the UMass Donahue Institute, and 94% would recommend the STEP program to other companies seeking technical and business support.

- The STEP program advanced several important state policy initiatives, including the strategic plan to promote the use of recyclable materials in Massachusetts, and the renewable energy portfolio standards.

- The STEP program began a unique project with the Massachusetts Water Resources Authority to demonstrate four technologies for reducing mercury emissions in wastewater from hospitals and laboratories. To date, two of the four technologies meet the new discharge standards.

"Over 80% of customers indicate that the services they received through STEP were important or critical to their technology's advancement."

The Donahue Institute
University of Massachusetts

The STEP Mission

Launched in 1994, the STEP initiative draws on the extensive resources of its partner agencies – the Executive Office of Environmental Affairs, the Department of Economic Development, and the UMass System. These three agencies, together with the state's Division of Energy Resources, provide assistance to firms that are engaged in developing and commercializing innovative envirotechnologies.

The STEP partner agencies and research centers guide envirotech entrepreneurs through the different stages of technology development, beginning with a promising idea, then advancing to proof of concept and pilot testing, through prototype development and demonstration, and finally to commercial introduction, production, and sales.

As part of this process, STEP works with companies to identify and overcome regulatory barriers that might otherwise block the introduction of a promising envirotechnology. In addition, drawing on their extensive contacts in both the business and government sectors, STEP staff members are often able to introduce technology developers to potential clients and state procurement officials. By nurturing fledgling envirotechnologies, the STEP program enhances environmental protection and energy efficiency in Massachusetts and promotes economic development in the state.

STEP's Business, Regulatory, and Technical Support

A Full Spectrum of Services

STEP staff members evaluate the specific needs of each company and offer individualized assistance. The broad array of STEP services may be divided into the following major categories:

Business Support Services

- Refining business plans
- Identifying financing sources
- Targeting niche markets
- Making introductions to state procurement officials

Regulatory and Permitting Assistance

- Identifying relevant regulations and permitting requirements
- Addressing regulatory issues
- Determining the applicability of new technologies to environmental problems
- Evaluating the potential of existing requirements to create new market opportunities

Technology and Business Assessments

- Verifying the technology's cost, performance, and potential markets
- Evaluating the company's management and business plan
- Helping firms achieve credibility in the business community, and thereby attract financing

Applied Research and Development Projects

- Supporting R&D projects involving private-sector scientists and UMass faculty members and students
- Strengthening ties between UMass and its industry research partners

Demonstration Projects

- Providing opportunities for companies to test their technologies
- Verifying performance through demonstrations
- Introducing companies to potential clients that might host demonstration projects

Access to Interstate Markets

- Promoting technology acceptance in other states
- Sharing information and reducing uncertainties about new technologies

Donahue Institute's Assessment of the STEP Program: "A Solid Success"

In 1998, the Donahue Institute – the public service and outreach unit of the UMass President's Office – conducted a three-year program review of STEP. For their assessment, the Donahue Institute staff reviewed STEP program documents, interviewed STEP officials, and surveyed 35 companies that have received STEP assistance.

"Clearly, STEP has achieved solid success in its first years of operation," according to the Donahue report. "It has done so by offering very good customer service and a high caliber of business and technical assistance." Many companies have reported that STEP's technology and business plan reviews have given their firms "increased credibility" in the business community, which has helped them attract investors and customers.

In their responses to the Donahue Institute's survey, companies often praised the STEP program for providing them with access to technical resources, including UMass academic expertise and laboratory facilities. Some firms noted that this technical assistance was essential for the completion of their research work. Over 80% of the companies surveyed indicated that STEP assistance was important or critical to the advancement of their technologies.

For many companies, the STEP program has also made Massachusetts state agencies more accessible by introducing firms to the state's business development, environmental, and purchasing officials, according to the Donahue report.

Executive Office of Environmental Affairs

Assisting Innovative Technologies through Regulatory Support

"EOEA helps companies with market-ready technologies to gain access to potential markets both inside and outside Massachusetts."

The Executive Office of Environmental Affairs (EOEA) coordinates the implementation of the STEP program. The agency works with other STEP partners to perform the initial evaluations of companies to determine what services might be useful to them. As part of these reviews, EOEA's Department of Environmental Protection (DEP) evaluates state regulatory requirements to ensure a level playing field for individual innovative technologies. State regulators may also offer expedited permit review when appropriate. Another EOEA unit, the Office of Technical Assistance for Toxics Use Reduction (OTA), assesses the potential merits of the technologies.

In addition, EOEA helps companies with market-ready technologies to gain access to potential markets both inside and outside Massachusetts. The agency collaborates with the Operational Services Division (OSD) – the state's central purchasing office – to encourage state agencies and political subdivisions to purchase environmentally sound products and technologies, including those developed by STEP companies. For example, in 1998, OSD issued a statewide contract for environmental diagnostic technologies to five vendors, including **AIRxpert Systems** (Lowell), a STEP company that provides indoor air diagnostic services.

STEP firms can also benefit from EOEA's role in the Six-State Partnership for Environmental Technology, an initiative designed to accelerate the permitting process and promote the acceptance of promising environmental technologies in Massachusetts, California, Illinois, New Jersey, New York, and Pennsylvania.

EOEA staff members work closely with the UMass applied research and development centers both in identifying industrial problems that require further investigation and in reviewing proposals for STEP-funded research at UMass. Many of the applied research and development projects for FY 1999 address environmental concerns identified by EOEA.

Department of Economic Development

Stimulating the Growth of Envirotechnology Companies

Within the Department of Economic Development (DED), the Massachusetts Office of Business Development (MOBD) assists STEP firms by reviewing their business and marketing plans. It also helps these firms gain access to investment capital from both government and private sources.

MOBD was a cosponsor of the U.S. Environmental Protection Agency's Venture Capital Forum, which was held in May 1998 concurrently with the EnviroExpo-New England. Two Massachusetts companies – **Aquator Products Ltd.** (Wellesley) and **Bestmann Green Systems** (Salem) – made presentations to a group of potential investors at the forum. MOBD continues to assist these firms in their efforts to raise capital.

Before Fiscal Year (FY) 1998, DED offered additional STEP services through the Division of Energy Resources (DOER), which has since moved to the Massachusetts Office of Consumer Affairs and Regulation. Despite its move to another agency, DOER remains linked to the STEP program through its support of research projects at UMass-Amherst's Center for Energy Efficiency and Renewable Energy.

The University of Massachusetts System

Helping Firms Develop and Commercialize Envirotechnologies

The UMass System's participation in STEP provides UMass faculty members and students with the opportunity to build fruitful relationships with entrepreneurs and scientists in the private sector. In 1998, UMass received an allocation of $2 million from the Massachusetts state legislature to support STEP activities at UMass campuses in Amherst, Boston, Dartmouth, and Lowell and at their affiliated research centers.

Of this total amount, UMass used about $1.2 million to support more than 40 applied research and development projects at six UMass-affiliated state-of-the-art research centers. Over 250 UMass faculty members and students worked on these projects, deepening their technical and business expertise in the process, while providing the participating firms with access to UMass research facilities and staff. Industry and government partners contributed more than $500,000 in additional cash and other resources to these research efforts.

of STEP Partners

UMass-Amherst

National Environmental Technology for Waste Prevention Institute

Redesigning Manufacturing Processes

UMass-Amherst's National Environmental Technology for Waste Prevention Institute (NETI) brings together UMass faculty members and students with industry partners on research projects to reduce waste and prevent pollution within manufacturing processes. The overall objective of NETI's STEP-supported research is to develop the science and engineering base needed to change manufacturing from a polluting process to a more efficient process with low or no environmental impact. NETI is using about $533,000 in STEP funding to support nine projects in FY 1999, which began on 1 July 1998. NETI's 19 industry partners for these projects have agreed to provide about $400,000 in additional direct or in-kind support.

"The overall objective of NETI's STEP-supported research is to develop the science and engineering base needed to change manufacturing from a polluting process to a more efficient process with low or no environmental impact."

A major new initiative for FY 1999 is NETI's funding of two group projects – research efforts involving multidisciplinary faculty teams and multiple industrial partners. Group projects are designed "to address complex problems by building on the synergy in research expertise among faculty and departments," according to NETI Advisory Board Chair Joseph Larson.

During FY 1998, a total of 102 students either worked on NETI projects or benefited from the results as professors incorporated the research results into classroom or laboratory instruction. "Students who have directly participated in NETI research are already taking their manufacturing process design expertise into jobs in industry and the public sector," Larson says. As an added benefit, NETI's university-industry projects have brought substantial R&D funds from industry to UMass-Amherst. Over the past five years, 34 different industry partners have provided a total of about $1.2 million in direct or in-kind support for NETI research projects.

NETI has also achieved national recognition as a leader in environmental R&D. In June 1998, at the request of the U.S. Department of Energy, NETI convened a workshop of 50 top scientists and government policy-makers to assess the role of polymer research in the national Green Chemistry program. The workshop participants predicted that, with continued R&D, green chemistry techniques could eliminate nearly all emissions and raw material wastes in polymer manufacturing by the year 2020, while saving nearly half the energy now used in polymer production.

Center for Energy Efficiency and Renewable Energy

Supporting Renewable Energy Policy Initiatives

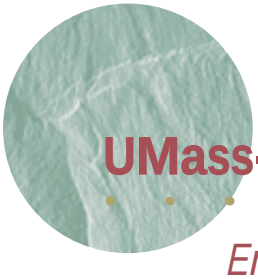
The primary mission of UMass-Amherst's Center for Energy Efficiency and Renewable Energy (CEERE) is to coordinate UMass research in renewable energy, energy efficiency, and associated environmental issues. CEERE staff have also developed extensive expertise in treatment technologies for groundwater, stormwater, and wastewater. CEERE receives about $90,000 in funding from STEP and additional support from the state's Division of Energy Resources.

During 1998, CEERE provided technical assistance to 12 companies, with technologies ranging from hydroelectric, solar, and wind energy systems to

pollution monitoring and cleanup equipment. CEERE staff members conduct many of the STEP program's technology assessments, and also perform a variety of other technical services, such as advising companies about ways to improve product design, and coordinating field testing for promising technologies.

In addition, CEERE supports DOER's energy policy initiatives, including efforts to increase the use of renewable energy resources in the state. During 1998, CEERE completed a white paper summarizing the technical issues related to the implementation of the state's Renewable Portfolio Standard. The standard, which is under development, will require that a minimum percentage of the power sold in Massachusetts be generated from new renewable energy facilities.

CEERE also began work during 1998 on five other white papers focusing on the environmental and technical aspects of energy development in Massachusetts and the other New England states. "This energy policy work supports the STEP agenda, because the development of a good energy efficiency and renewable energy policy could have a significant impact on economic development in Massachusetts," according to CEERE's Associate Director James Manwell.



UMass-Boston

Environmental Business and Technology Center

Positioning Companies for Commercialization

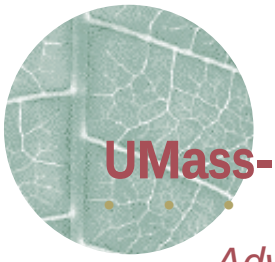
The Environmental Business and Technology Center (EBTC) at UMass-Boston's College of Management focuses on helping entrepreneurs transform their environmental innovations into marketable products and processes. With $375,000 in STEP funding for FY 1999, EBTC often takes a lead role in the review and selection of companies seeking assistance from one or more STEP agencies and UMass research centers.

EBTC screened over 40 companies in 1998, and provided substantial technology assessment, demonstration, and commercialization assistance to a total of 16 firms. In addition, EBTC publishes STEP's quarterly newsletter titled *Massachusetts Environmental Ventures*, which is available by mail on request.

In addition, EBTC offers a series of intensive workshops tailored to the specific needs of STEP companies that are preparing to commercialize their technologies. During 1998, EBTC conducted commercialization workshops for **Environmental Management Technologies/Ariano PetroTrace** (Milton), **Global Recycling Technologies** (Stoughton), **Goal Line Environmental Technologies** (Knoxville, TN), **Guardian Environmental Technologies** (Kent, CT), and **Physical Sciences, Inc.** (Andover).

One of those companies – Environmental Management Technologies – succeeded in obtaining a commitment for $300,000 in funding from the Massachusetts Technology Development Corp. after the firm revised its business vision as a result of EBTC's business assistance.

Through a workshop, EBTC helped Physical Sciences, Inc. (PSI) evaluate the commercial potential of five innovative environmental technologies that the company has developed. As a result, PSI decided to focus on commercializing its SIBS Heavy Metal Detector, which uses a plasma-based technology to measure the concentrations of heavy metals in air, soil, and water. EBTC is currently working to help PSI develop a business strategy and reach potential investors and industrial partners – such as environmental consulting firms or instrumentation companies – that could make extensive use of PSI's detection technology.



UMass-Dartmouth

Advanced Technology and Manufacturing Center

Conducting Applied R&D on Green Technologies

The Advanced Technology and Manufacturing Center (ATMC) is responsible for managing STEP activities at UMass-Dartmouth. "ATMC brings together UMass-Dartmouth faculty members and Massachusetts firms to conduct research on developing new technologies that are both environmentally and economically sound," according to Daniel Murphy, ATMC's Director. For FY 1999, ATMC is supporting nine projects in a variety of research areas including aquaculture, groundwater remediation, pollution detection, stormwater and wastewater treatment, watershed management, and renewable energy.

"ATMC brings together UMass-Dartmouth faculty members and Massachusetts firms to conduct research on developing new technologies that are both environmentally and economically sound."

Daniel Murphy
Director
Advanced Technology and Manufacturing Center

"Four of the projects are new research efforts, while the other five continue research begun in FY 1998," according to Murphy. Two of the four new projects are designed to improve control systems and water quality at aquaculture facilities. UMass-Dartmouth has established an aquaculture research laboratory to support such projects, which could ultimately increase fish production while reducing environmental pollution. The total budget for ATMC's nine FY 1999 projects is $469,000, consisting of $287,000 in STEP funds, and $182,000 in cash and in-kind contributions from industry and government research partners.

In addition, ATMC has budgeted $50,000 of STEP funds to conduct technical assessments in response to requests from industry, EOEA, and MOBD. ATMC is also using $30,000 of STEP funds to support the work of UMass-Dartmouth's Center for Marine Science and Technology (CMAST). CMAST is conducting a marine environmental assessment for the southern Massachusetts coast and evaluating actions that area industries are taking to address the region's environmental problems.

UMass-Lowell

Center for Environmentally Appropriate Materials

Promoting Sustainable Technologies

The Center for Environmentally Appropriate Materials (CEAM) at UMass-Lowell promotes the design and use of processes and materials that are safe, appropriate, and compatible with the environment. CEAM administers all of the STEP activities at UMass-Lowell, including the work of the University Research in Sustainable Technologies Program and the Chelsea Center for Recycling and Economic Development.

The Sustainable Technologies Program, which was launched in FY 1998, is a joint project between CEAM and UMass-Lowell's Toxic Use Reduction Institute. The program promotes the design, development, and evaluation of sustainable technologies that are economically and environmentally sound.

With funding from STEP, CEAM has awarded grants totaling $170,000 to support eight research projects in FY 1999, including four projects that continue research conducted during the previous year.

In the Sustainable Technologies Program, the research topics for FY 1999 include: alternatives to PVC for bags containing blood or intravenous solutions; acid recovery in metal-working and finishing processes; enzymatic synthesis of phenolic polymers; solubility research for "green" chemistry applications; additive technologies for the manufacture of printed wiring boards; alternatives to heavy metal additives in the plastics industry; energy and resource efficiency models for UMass buildings; and de-inking technology for mixed office paper.

Chelsea Center for Recycling and Economic Development

Fostering the Use of Recycled Materials

The Chelsea Center for Recycling and Economic Development works to increase the use of recovered materials by manufacturers, and thereby increase employment, boost the economy, and improve environmental quality in Massachusetts. For FY 1999, the Chelsea Center is receiving $239,000 from STEP and $727,000 from the state's Clean Environment Fund to support its activities.

In its capacity as a STEP partner, the Chelsea Center provides extensive business and technical assistance to manufacturers that use, or are interested in using, recovered materials. For example, the Chelsea Center provides manufacturers with grants to develop and test recovered materials and end-products. Grants are also available to help manufacturers offset the costs of exhibiting their products at trade shows.

Through its recycling intern program, the Chelsea Center arranges for, and pays stipends to, student interns from UMass and other colleges in Massachusetts. In 1998, 17 student interns provided assistance to nine companies and government agencies on a variety of projects.

To gather and disseminate information about recovered materials and products, the Chelsea Center holds workshops and forums tailored to the specific interests of the manufacturing, research, and financial communities. The Chelsea Center also publishes a newsletter and technical reports about recycling-related issues, as well as a *Directory of Recycled Products Manufacturers*. The current edition of the *Directory* profiles more than 170 companies that use recovered materials.

The Chelsea Center promotes the procurement of recycled products made in Massachusetts by working with state agencies and the **Buy Recycled Alliance**. In addition, during early 1999, the Chelsea Center will complete a *Strategic Plan to Promote the Use of Recovered Materials in Massachusetts*.

Business Support Services

Bridging the Gap between Technology Development and Market Acceptance

The STEP program provides business support services to help entrepreneurs develop and refine their business plans, identify and tap promising markets, and line up the financing needed to move their technologies from the lab to the marketplace. For example, in 1998, EBTC and EOEA organized a workshop at the UMass Medical Center in Worcester to showcase **Ion Signature Technology**'s patented Ion Fingerprint Detection (IFD) analytical software for the Massachusetts Department of Environmental Protection (DEP) Laboratory Advisory Committee and the state's certified laboratories.

IST demonstrated its IFD software for about 40 workshop participants and presented a case study describing the use of the technology to analyze samples from a contaminated site. The director of DEP's Wall Experiment Station in Lawrence also summarized performance tests showing that, compared to a competing Hewlett Packard software product, the IFD software provided faster and more accurate identification of target compounds in highly contaminated samples.

"DEP did a very good job of presenting the benefits and applications of our IFD software," according to IST Chairman Albert Robbat, Jr. "As a result of the STEP-supported workshop on our software, several labs agreed to serve as beta test sites," Robbat says. "The data we gathered from these beta tests helped us make final refinements to the IFD software before launching it commercially in early 1999." During 1998, IST forged a channel partnership agreement with LINC Quantum Analytics (Foster City, CA), one of the nation's largest lessors and renters of analytical instruments. LINC Quantum will use its U.S. and European sales forces to help market and sell the IFD software.

Supporting Wider Product Exposure

The Chelsea Center for Recycling and Economic Development provided a variety of business assistance in 1998 to companies that make or use recycled materials and products. For example, the Chelsea Center helped 13 recycled-products manufacturers reach potential customers by providing grants to offset the costs of exhibiting at three major environmental events – EnviroExpo-New England, State Recycled Products Vendor Fair, and Build Boston. One of these manufacturers, **SelecTech, Inc.** (Taunton), exhibited its extensive line of recycled plastic products, including vinyl flooring, planters, speed bumps, and lightweight plastic lumber, which are made from many different types of recycled feedstocks.

"The Chelsea Center exhibit grants helped us get the word out about our products, and make important contacts with potential customers," according to SelecTech President Tom Ricciardelli. SelecTech's annual sales of recycled plastic products increased from $140,000 in 1996 to about $1.1 million in 1998, Ricciardelli says.

"The Chelsea Center exhibit grants helped us get the word out about our products, and make important contacts with potential customers."

Tom Ricciardelli
President
SelecTech, Inc.

Regulatory and Permitting Assistance

Leveling the Playing Field for New Envirotechnologies

Understanding and complying with regulations and permitting requirements are critically important for fledgling companies hoping to commercialize an innovative envirotechnology. Before launching their products, entrepreneurs must first determine what state and federal regulations apply to their technologies, and compile the information that regulators will need to evaluate and approve their products. In addition, evaluating information about environmental problems and specific environmental regulations can help entrepreneurs identify industries and applications that might benefit from their products.

"In Massachusetts, the shift from technology-specific permits to performance-based standards has opened up opportunities for the sale and use of new environmental technologies," according to EOEA's STEP Coordinator Paul Richard. Since its inception, the STEP program has helped environmental entrepreneurs collect reliable data on the cost and performance of their technologies and disseminate this information to regulators, potential clients, and investors, Richard says. EOEA and its regulatory units have also implemented policies to encourage the use of innovative environmental technologies.

Expedited Permitting for Waste-to-Energy Technology

As one of the STEP partner agencies, the Massachusetts DEP works closely with companies to accelerate the permitting process for innovative technologies. For example, in 1998, **Energy Transition Technology, Inc.** (ETTI) of North Andover received expedited permitting from DEP to deploy its customized gas turbines at three Massachusetts landfills in Acushnet, Northampton, and Worcester in order to meet the deadline for federal tax credits. The ETTI units are designed to generate clean electricity by burning methane gas extracted from the three landfills.

"We received a lot of help, not only from the permitting people at DEP, but also from STEP partners at UMass-Amherst and UMass-Boston, who evaluated our technology and business plans," according to ETTI Treasurer John Fitzgerald. He says that ETTI's turbines are due to begin operating during 1999.

In addition, as part of its new Stormwater Management Policy, DEP has encouraged developers of innovative stormwater technologies to seek the STEP program's help in verifying the performance capabilities of their technologies. DEP's guidance document implementing the policy encourages local conservation commissions to be open to innovative stormwater treatment technologies and to consider the findings of STEP assessments when approving new stormwater systems.

By the end of 1998, STEP had verified the technologies of two companies that have innovative stormwater treatment systems – **StormTreat Systems** (Sandwich) and **CSR New England Pipe** (Wauregan, CT). DEP has distributed fact sheets about these technologies to conservation commissions and consultants across the Commonwealth. STEP's assessments of these technologies have been posted on STEP's website.

Technology and Business Assessments

Evaluating the Cost, Performance, and Markets for Promising Technologies

For its technology and business assessments, the STEP program analyzes a company's management and business plan and, when appropriate, recommends ways to improve the company's technology, management structure, and marketing strategy. Although STEP does not endorse specific products or technologies, some companies have found that the STEP assessments have increased their credibility in the business community, making it easier to attract financing and market their products to potential customers.

"STEP's favorable business and technical assessment of our company continues to help us build our customer base."

Owen Boyd
Chairman
SolmeteX, Inc.

"STEP's favorable business and technical assessment of our company continues to help us build our customer base," according to Owen Boyd, Chairman of **SolmeteX, Inc.** (Billerica). In 1998, SolmeteX became the exclusive supplier of wastewater treatment equipment for clinical chemistry analyzers marketed by Beckman Coulter, Inc. (Brea, California), a company with annual sales of over $2 billion. Beckman is now marketing SolmeteX treatment systems with its new clinical analyzer units, and is also offering to retrofit existing analyzer units with SolmeteX treatment systems. SolmeteX estimates that sales of its wastewater treatment systems through Beckman could total $10 million over the next several years.

"Our work with STEP also caught the attention of the Department of Energy's Oak Ridge National Laboratory (ORNL)," according to Boyd. "After testing our Keyle:X mercury-removal process, ORNL selected the technology to clean up mercury contamination at a major research laboratory in New York State." Boyd estimates that the company's installed base of Keyle:X units will recover about 500 pounds of mercury from 30 million gallons of contaminated water during 1999. In Massachusetts alone, according to Boyd, Keyle:X systems installed at clinical laboratories, hospitals, medical waste incinerators, and a Department of Defense site are expected to reduce mercury pollution by about 300 pounds – an amount equal to about 3 percent of the state's total annual emissions of mercury.

Building Credibility with Potential Clients

The Massachusetts sales of another company, **CSR New England Pipe** (Wauregan, CT), increased dramatically after UMass-Amherst's CEERE published a favorable assessment of the Stormceptor stormwater treatment system in early 1998. CSR is licensed to sell the Canadian-based Stormceptor technology throughout New England. To reduce pollution from the Central Artery Tunnel project, the Massachusetts Highway Department and the Massachusetts Turnpike Authority have recently ordered more than 50 Stormceptor units, which will be delivered between 1999 and 2001, according to CSR's Technical Director Rhett Grant. "I attribute all of this increase to CEERE's validation of our technology and distribution of the report's findings."

Applied Research and Development Projects

Greening Manufacturing Operations in Massachusetts

Each year, the STEP program funds numerous research and development (R&D) projects to prevent waste, reduce pollution, conserve energy, and harness renewable energy sources. UMass faculty members and students work with industry partners on joint projects, strengthening ties between the University and the private-sector research community. The largest of the STEP-supported R&D programs is at UMass Amherst's NETI. During FY 1999, NETI and 19 industry partners are undertaking nine applied R&D projects, representing a total research investment of nearly $1 million.

Through STEP, NETI has provided multiyear support for a number of projects, including research to develop "green" cooling techniques for grinding operations used in manufacturing. Conventional grinding operations typically use large amounts of soluble oils, which are a source of pollution and hazardous to human health. During the past three years, a UMass-industry team led by UMass-Amherst Distinguished Professor Stephen Malkin has been investigating alternatives to the current approach to provide cooling for grinding operations.

"Grinding is at work in every precision-manufacturing process anywhere, and the use of small amounts of non-hazardous ester oil in combination with cold air looks particularly promising as a cooling approach," according to Malkin. Chi-Hung Shen, Manager of Machining Systems for **General Motors**' Global Research and Development Operations — one of the industry partners in the project — says: "The health hazards and environmental impacts of existing metalworking fluids have been major and ongoing concerns for our industry. Having a nontoxic alternative would have a profound positive effect on our industry."

Undertaking Cutting-Edge Research on Heat Pumps

UMass-Dartmouth's ATMC is also supporting a variety of applied R&D projects with its STEP funds, including research to refine ground-source heat pump (GSHP) technology. GSHPs use a heat exchanger system that allows heat to be transferred between a building and the underlying ground, which remains at a fairly steady temperature throughout the year. During cold weather, the heat exchanger extracts heat from the relatively warm ground to heat the building, while during hot weather, the exchanger transfers excess heat from the building into the relatively cool ground.

ATMC has established a university-operated laboratory to develop more economical GSHP hardware, and is working with **G.M. Refrigeration** (Fall River) to design a GSHP system for a state office building in Taunton. "Our work will lower the capital costs of GSHPs, because right now they are over designed," according to Ronald DiPippo, the UMass-Dartmouth engineering professor who is principal investigator for the GSHP project. ATMC Director Daniel Murphy notes that, "as more of these redesigned heat pumps are used in place of conventional heating and air-conditioning systems, there could be a significant reduction in the use of fossil fuel."

Access to Interstate Markets

"The Six-State Partnership has already helped us gain the permits we needed to install our CAST technology at a major metal plating company in New Jersey."

John Gannon
President &
Chief Executive Officer
CASTion Corp.

Increasing Sales by Opening New Markets

In addition to nurturing envirotechnologies in Massachusetts, the STEP partners are dedicated to promoting the adoption of new envirotechnologies in other states. The STEP program has helped companies like Ludlow-based **CASTion Corp.** – formerly Cellini Purification Systems – access interstate markets. In 1996, officials from the Massachusetts DEP and EPA Region 1 jointly determined that CASTion's Controlled Atmosphere Separation Technology (CAST) system meets the criteria for a "totally enclosed" hazardous wastewater treatment system and is therefore exempt from the permitting requirements of the federal Resource Conservation and Recovery Act.

This exemption has cleared the way for the company's technology to be installed throughout EPA Region 1, which covers the New England states. By the end of 1998, CASTion had installed its CAST systems at about 20 facilities, mostly in New England. The six treatment systems installed in Massachusetts are allowing facilities here to recover and reuse over 3,500 gallons per day of industrial rinsewater, according to CASTion President and Chief Executive Officer John Gannon. Without treatment, this rinsewater would have to be disposed of as hazardous waste. Gannon says the number of installations in Massachusetts will likely triple by the end of 1999, reducing hazardous waste volume by 10,500 gallons per day.

Interstate Partnership Expedites Technology Acceptance

STEP staff members have also developed close working relationships with environmental officials in other states through the Six-State Partnership for Environmental Technology, an initiative designed to accelerate the permitting process for promising envirotechnologies and promote their acceptance in Massachusetts, California, Illinois, New Jersey, New York, and Pennsylvania.

"We expect that the Six-State Partnership will be a huge help in expanding our sales beyond the New England region," according to CASTion's Gannon. "The Six-State Partnership has already helped us gain the permits we needed to install our CAST technology at a major metal plating company in New Jersey." STEP's favorable business and technology assessments of the CAST technology also helped CASTion attract $1.5 million in new equity financing from Green Mountain Energy in Burlington, Vermont. CASTion is using the capital to launch "an aggressive commercialization program," Gannon says.

Demonstration Projects

Testing Technologies under "Real World" Conditions

STEP demonstration projects provide environmental entrepreneurs with the opportunity to identify the strengths and weaknesses of their technologies, and make any necessary improvements. Participating companies may also benefit from working with potential clients at demonstration sites. For example, when demonstration projects are conducted at state facilities, entrepreneurs often have the chance to work with the government officials who are responsible for monitoring the performance of environmental technologies. If the technology performs well, the company may gain a foothold in the Massachusetts market.

Cutting Mercury Emissions in Wastewater

One of the STEP program's ongoing demonstration projects focuses on technologies to reduce mercury emissions in wastewater from hospitals and laboratories. The demonstration project is a collaborative effort among EOEA, UMass-Boston's EBTC, the Massachusetts Water Resources Authority (MWRA), five technology companies, and three hospitals and research centers.

The five companies – **ATA Technologies Manufacturing Corp.** (Cleveland, OH), **ICET, Inc.** (Norwood), **SolmeteX** (Billerica), and **Prosys Corp.** (Chelmsford) in partnership with **DuBois Chemicals** (Greenville, RI) – are providing four different technologies that reduce mercury emissions either at the point of use or at the "end of the pipe." Point-of-use systems are designed to prevent mercury from entering a facility's plumbing system, while end-of-pipe systems are designed to remove mercury contamination from the facility's wastewater before the water is discharged into the public sewage system.

Pilot tests of the mercury-removal technologies are now under way at **Brigham and Women's Hospital** (Boston), **Newton-Wellesley Hospital** (Newton), and the **U.S. Department of Agriculture's Human Nutrition Research Center on Aging** at Tufts University (Boston). "As of December 1998, the tests showed that, under certain field conditions, two of the four technologies can reach MWRA's target mercury level of less than 1 microgram per liter of water," according to Gordon Wallace, UMass-Boston Project Scientist and Professor. One important goal of the mercury-removal project is to reduce mercury releases to that standard consistently. The pilot tests will be completed by mid-1999.

Transforming Biodegradable Wastes into Useful Compost

In another demonstration project – initiated by DEP – UMass-Amherst, UMass-Lowell's CEAM, and DEP's Division of Solid Waste Management are conducting an ongoing evaluation of a Wright In-Vessel Composting Unit at the UMass-Amherst campus. The system, which is manufactured by **Wright Environmental Management** (Toronto, Ontario), transforms a variety of biodegradable organic wastes – including food wastes, cardboard, paper, leaves, and grass – into useful compost.

"The composting of biodegradable organic wastes represents an attractive alternative to disposal in landfills," according to CEAM Director Charles Pace. These wastes account for an estimated 18 to 26 percent of the municipal solid waste stream in Massachusetts. "Information gained through UMass's In-Vessel Composting project could be readily transferred to other public and private institutions to facilitate the development of composting programs throughout the Commonwealth and beyond," Pace says. The wider use of composting could substantially decrease the volume of material disposed in landfills, and reduce solid waste loading in municipal sewer systems and wastewater treatment facilities.

Companies that Received STEP Assistance during 1998

Adrenaline Research (Hudson)
Advanced Environmental Products (Vineyard Haven)
Affiniti Water Technologies (Scituate)
AIRxpert Systems (Lowell)
Allied Signal Aerospace (Tempe, AZ)
Alpha Gary (Leominster)
ALZA (Palo Alto, CA)
American Adhesive Coating (Natick)
American Reclamation (Charlton)
Amoco Chemicals (Naperville, IL)
Applications Technology Institute (Seattle, WA)
Applied Advanced Technologies (Winchester)
AquaFuture (Turners Falls)
Architectural Timber and Millwork (Hadley)
ATA Technologies Manufacturing (Cleveland, OH)
Atlantic Orient (Norwich, VT)
Atlon Labs (Framingham)
AWT Environmental (New Bedford)
B&D Aquatics (New Bedford)
Baystate Fertilizer (Boston)
Belcher (Easton)
Benthos (North Falmouth)
Breshears Design and Research (Watertown)
Brigham and Women's Hospital (Boston)
CASTion (formerly Cellini Purification Systems) (Ludlow)
Chand Kare Technical Ceramics (Worcester)
ChemDesign (Fitchburg)
ChemMotif (Concord)
Circuits Plus (Randolph)
Conigliaro Industries (Framingham)
Creative Paper (Worcester)
CSR New England Pipe (Wauregan, CT)
Dow Chemical (Freeport, TX)
DuBois Chemicals (Greenville, RI)
Dupont Central Research and Development (Wilmington, DE)
Eastman Kodak (Rochester, NY)
East-West Education Development Foundation (Boston)
Eco Boom (Sea Cliff, NY)
Electric Machine Systems (Bedford)
Energy Transition Technology (North Andover)
Engelhard (Iselin, NJ)
Engineered Polymers (Chicopee)
Environmental Management Technologies (Milton)
Environmental Solutions International (Windsor, CT)
Erickson Materials (Woburn)
Erving Paper Industries (Erving)
F&B Enterprises (New Bedford)
Flippo Construction (Forestville, MD)
GE Plastics (Selkirk, NY)
General Motors (Warren, MI)
GI Plastek (Newburyport)
G.M. Refrigeration (Fall River)
Global Recycling Technologies (Stoughton)
Gloucester Co. (Franklin)
Goal Line Environmental Technologies (Knoxville, TN)
Greenglass USA (Great Barrington)
Griffin Manufacturing (Fall River)
Guardian Environmental Technologies (Kent, CT)
HiTech Hose (Newburyport)
H.I.L. Technology (Portland, ME)
ICET (Norwood)
Infiltrator Systems (Old Saybrook, CT)
Innovative Recyclers (Chicopee)
Ion Signature Technology (Cambridge)
ITW Vortek (Cincinatti, OH)
JBF Environmental Systems (Natick)
Kelemen Kuatro Glassart (Somerville)
Lake Front Enterprises (Norfolk)
Landis Gardner (Waynesboro, PA)
Laser Two (Burlington)
Loctite (Rocky Hill, CT)
Longleaf Lumber (Somerville)
Markem (Keene, NH)
Micromag (Framingham)
Micron Air Purification (Longmeadow)
Millipore (Bedford)
Mitsubishi Chemicals (Japan)
Morton International (Danvers)
Multi-Pure (Chatworth, CA)
National Fiber (Belchertown)
New Frontier Plastic (West Springfield)
Newton-Wellesley Hospital (Newton)
Norton Co. (Worcester)
Nypro (Clinton)
Oracle (Waltham)
Osmonics (Minnetonka, MN)
Osmos International (Lowell)
Paradise City Glassworks (Florence)
Pax Analytics (Colrain)
PBE International (Raynham)
Physical Sciences, Inc. (Andover)
Praxair (Tarrytown, NY)
Proctor & Gamble (Cincinnati, OH)
Prosys (Chelmsford)
Radiance Service (Bethesda, MD)
Recycline (Somerville)
Red Sun Press (Boston)
ReHarvest (Concord, NH)
Rexam Graphics (South Hadley)
Routhier and Sons (Littleton)
Searle (Skokie, IL)
Second Wind (Somerville)
SelecTech (Taunton)
Shell Chemical (Houston, TX)
Simulprobe Technologies (Mill Valley, CA)
Sirius Pulp and Paper (Granby, CT)
SKF Technical Development Center (Sweden
SolmeteX (Billerica)
Sterling Art Glass (Sterling)
Stormceptor Canada (Toronto, Ontario)
Stormtreat Systems (Sandwich)
Talbert Trading (Worcester)
The Conservation Consortium (South Yarmouth)
Thermatrix (San Jose, CA)
3M (St. Paul, MN)
Torrington Co. (Torrington, CT)
Tougher Industries (Albany, NY)
U.S. Department of Agriculture's Human Nutrition Research Center on Aging (Boston)
United Technologies (East Hartford, CT)
Venturi Aeration (Pelham, NH)
Vortechnics (Portland, ME)
Waste Stream Environmental (Agawam)

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